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ABSTRACT

A study examined what happens to student writing processes when word processing is combined with process-oriented composition instruction, and what effect this combination has on writing quality. The quantity of drafting and the amount of time spent on revisions were logged for 13 college students. In addition, a questionnaire was sent to 31 students to elicit their responses to word processing as a writing tool, to discern whether students perceived their composing processes to be changing as a result of using word processing, and to discover how they felt individual conferences affected their writing. Finally, a control group of 44 college students receiving process-oriented instruction but not using word processing was compared to an experimental group of 35 students receiving similar instruction while using word processing. The results showed that the 13 writers composed a mean of 5.51 drafts in a mean time of 9.84 hours. Revision analysis indicated the writers fluctuated widely in their computer composing styles, revision choices, and emphases. The questionnaire responses tended to be positive regarding word processing, particularly as an editing and revising tool, though technical problems were noted. Lastly, the comparative analysis showed that control group writers improved .46 points on a 12-point holistic scale, while experimental group writers improved 1.26 points. Overall, the results suggest that word processing in process-oriented writing classrooms often positively influences student writing. (HOD)

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THE EFFECTS OF WORD PROCESSING AND WRITING INSTRUCTION ON THE WRITING PROCESSES AND PRODUCTS OF COLLEGE WRITERS

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THE EFFECTS OF WORD PROCESSING AND WRITING INSTRUCTION ON THE WRITING PROCESSES AND PRODUCTS OF COLLEGE WRITERS

Abstract:

This study examined the effects of word processing and writing instruction on the writing processes and products of college writers. Methods included logging, a questionnaire, revision analysis and an experiment.

Logging results showed 13 writers composed a mean of 5.51 drafts (SD .66) in a mean time of 9.84 hours (SD .66) per complete text. Questionnaire responses by 31 writers tended to be positive regarding word processing, particularly as an editing and revising tool, though technical problems were noted. Revision analysis using Faigley and Witte's (1981) taxonomy indicated writers fluctuated widely in their computer composing styles, revision choices and emphases. Four writers made a mean of 164.6 revisions per 1000 words, including 74.63 surface changes and 89.93 meaning changes. Sentence revisions were most frequent, accounting for 44.3% of the total changes. Finally, a control group of 44 college students receiving process-oriented instruction but not using word processing was compared to an experimental group of 35 college students receiving similar instruction while using word processing. Results showed control group writers grew .46 points (SD 2.83) on a 12 point holistic scale while experimental group subjects grew 1.26 points (SD 2.27). A nested analysis of variance determined that treatment results were significant ($p = .03$).

Results suggest that word processing in process-oriented college writing classrooms often positively influenced student writing processes and products.

Introduction:

The purpose of this study was to answer two related questions: what happened to student writing processes when word processing was combined with process-oriented composition instruction, and what effect did this combination have on writing quality.

Such a study seemed critical for several reasons. First, word processing was generating much interest as an important new composing tool. Yet, the many claims made for the microcomputer, and word processing in particular, remained to be substantiated (Bridwell, Nancarrow & Ross, 1984; Shostak, 1982). Second, uses of microcomputers in the English classroom at the time this study was conducted were often limited and in conflict with research-based composition tenets. Much work with microcomputers in the writing classroom was restricted to use of drill and practice software to teach grammar and punctuation skills (Bork, 1982; Wresch, 1982). This use was not pedagogically sound: composition research has long offered strong evidence that direct teaching of grammar, usage and mechanics does not improve writing quality significantly (Braddock, Lloyd-Jones & Schoer, 1963; Loban, 1966; Moffett, 1968). Most composition theorists concur that writing is best taught as a process, not as a product or as isolated subskills, and that writers learn most profitably by working with evolving versions of their own texts (Beach, 1980; Flower, 1979; Huff, 1983; Judy, 1980; Murray, 1980; Perl, 1979). If microcomputers continued to be used in pedagogically unsound ways in the English classroom, negative rather than postive effects might have resulted (Bork, 1982; Bridwell et al., 1984).

This study, therefore, aimed to test the effectiveness of microcomputers

when used in non-trivial and integrative ways. Rather than assume that word processing inevitably enhances composing, I tested its value as a writing resource when combined with process-oriented writing instruction well-rooted in composition theory and research. I instructed writers in composition and I studied their uses of word processing, particularly for revision, in the classroom setting through the use of the qualitative and quantitative instruments discussed below.

Because virtually no research base had been established in the area of writing and word processing, this study employed multiple instruments to explore three separate strands of inquiry. Volunteer writers logged their drafting times and dates and answered a questionnaire about their uses of word processing. Textual revisions made in eight texts by four student writers were analyzed using Faigley and Witte's (1981) taxonomy. Finally, an experiment tested the effects of word processing in process-oriented college composition classrooms. These strands of research are presented more fully below.

I. STUDENT RESPONSE

How extensively did student writers create drafts of their writing when using word processing in the composition classroom, and how much time did they devote to their essays? Did student writers believe use of word processing helped them and affected their composing processes, and if so, how? To answer these questions, I asked student writers to log their revision processes and to respond to an extensive open-ended questionnaire. These responses are reported below.

Logging

The purpose of logging was to determine the quantity of drafting done by writers and the amount of time spent on revisions. Thirteen class members enrolled in my first year College Writing course during the spring semester of 1984 volunteered to participate in the logging study, collecting all drafts of all essays in their writing folders. Each participant recorded the following information on each draft of each writing task, whether handwritten or computer printout: name, date, draft number, approximate composing time. A draft was defined as a newly written or revised essay, and so a handwritten draft which was then typed into the microcomputer verbatim was not counted as a consecutive draft. Time calculations include only actual composing time and not prewriting activities before actual composing took place or time spent in conference or thinking about revision.

Participants composed 281 drafts of 51 separate pieces of writing, a mean of 5.51 drafts of the cues they wrote. The mean time devoted to each revision of a draft was 1.83 hours, with a mean composing time per product of 9.84 hours over a mean time period of 26.23 days.

These findings differ from those of many other researchers, who have shown that school writers, especially basic writers, tend to revise minimally (Bridwell, 1980; Sommers, N., 1980). Both quantities of drafting and time expenditures suggest that the writers in this study wrote for longer periods of time and with more sustained effort than other college writers whose composing processes have been studied (Perl, 1980a, 1980b; Sommers, N., 1980).

Voluminous revision over extended periods of time is not positive in itself (Faigley & Witte, 1981), but these results provide support for the claim made by many composition teachers that writers using word processing revise more than writers using traditional composing methods (Lindemann & Willert, 1985; Womble, 1985). Ease of revision with word processing, however, was only one factor in the voluminous drafting over extended periods of time. Instruction also strongly encouraged extended textual revision. Acting on conference dialogues, writers continued drafting until they believed their texts were complete.

Questionnaire

The questionnaire's purpose was to elicit student responses to word processing as a writing tool, to discern whether students perceived their composing processes changing as a result of using word processing, and to discover how students felt our individual conferences affected their writing.

Thirty-one writers, all enrolled in College Writing courses which included the use of word processing, responded anonymously to this extensive open-ended questionnaire in 1984. The mean year in college of the respondents was 2.23. The mean age reported was 20.96 years. Of those reporting gender (87%), 67% were men and 33% were women. Academic majors included a wide variety of areas.

Most writers reported enrolling in College Writing to improve their writing skills (79.4%), and slightly over half of the respondents also wanted to work with word processing (58.8%). English was the first language for most students; the remaining writers had at least eight years experience

in spoken English. Excluding College Writing, writers had taken a mean of 1.55 English and Writing classes in college, with a mean grade point reported of 3.06 on a 4.0 scale. Respondents reported at least some prior computer experience in many cases (70.6%); others had never had any experience of any sort with microcomputers (29.4%).

Respondents reported requiring a mean of 3.04 hours to master the basics of the word processing programs (Bank Street Writer, HomeWord and Applewriter), with a range from ten minutes to ten hours reported. They reported feeling comfortable after having used a word processing program for a mean time of slightly over five hours (5 hours, 3.08 minutes), with a range of no time to ten hours reported.

The student writers tended to indicate positive responses to word processing as a writing tool, and most respondents reported multiple advantages to computer composing. The majority of writers (96.8%) stressed how much easier, faster, better and less frustrating the editing process became. Almost as many writers (83.9%) described themselves as more willing or more eager to revise, and found revision itself more fun as well as easier. All respondents agreed they would continue to use word processing if given the opportunity.

But over half of the respondents (51.6%) also found some disadvantages to using microcomputers as writing tools. These disadvantages included learning to use a microcomputer with a word processing program, machine error, loss of text files, and laboratory conditions and hours. A minority of writers reported new problems such as machine dependency, eye fatigue, and loss of original composing processes.

Writers also answered a series of questions about the effects, if any, on their composing processes. Most writers (71%) did not think their prewriting processes were affected by the use of word processing. The remainder (29%) did find changes. These writers found prewriting faster and/or easier. Other writers (23%) stressed the ability to erase and insert as they were prewriting, believing this recursive activity to be a real advantage.

Close to half of the writers surveyed (48.4%) reported word processing was helpful in composing their first drafts. These writers stressed the ability to insert and delete text as the most significant factor changing their drafting processes. Some writers (19.4%) reported creating first drafts more quickly and/or more easily; other writers (6.5%) began writing first drafts for the first time. Some writers (12.9%) reported writing less detailed first drafts, no longer trying for perfection. One writer reported, "I now write simpler drafts and write more directly in the computer, knowing that a mistake can be easily erased. It leaves me more time to worry about organization."

Most writers (87.1%) saw changes in their revision processes. These writers learned to perceive revision as major textual reworking rather than error correction. Writers also sometimes reported revision processes becoming more recursive. As one respondent observed, "My revision has changed from just one step to a multitude of steps occurring at any time during the working of a paper." Most writers (90%) also saw changes in their editing processes and believed they were more thorough as editors, either spending more time making corrections or doing so more often.

When asked how their individual writer/instructor conferences affected their writing, most of the questionnaire respondents (96.8%) were positive. Over half (61.3%) specifically stated that they found conferences very helpful in improving their writing, and some of these respondents (21%) believed conferences, not word processing, made them better writers. Writers isolated three specific areas where conferences were helpful: receiving information about writing; assistance in reshaping negative affective attitudes about writing; developing audience awareness and receiving audience feedback.

II. REVISION ANALYSIS

Overview

Composition theorists widely recognize the critical function of revision in mature composing processes; but inexperienced writers tend to revise prematurely and inadequately, concentrating on surface level errors rather than on textual construction (Perl, 1979; Sommers, N., 1980). Because textual changes seem so much easier to accomplish with word processing, composition researchers sometimes tend to assume use of word processing inevitably must be an invaluable composing tool, especially for revision. Presumably writers almost automatically feel freer to experiment and to take risks they might not otherwise attempt (Daiute, 1983; Schwartz, 1982). However, no research yet shows revision to be easier or more thorough when word processing is used. Evidence suggests, in contrast, that word processing may encourage shallow textual revision, an emphasis on form rather than meaningful textual revision (Bridwell & Duin, 1985; Collier, 1983).

The purpose of the analysis conducted here was to explore the types of revisions student writers made when using word processing as one of their writing tools. Were these changes shallow or significant, or were they both? How did writers differ from one another in their revision processes using word processing? How did these revision choices compare with the revision choices made by student writers in other studies who were not using word processing while revising?

Several classification systems have been constructed to classify textual revisions, notably Bridwell's (1980). Since a major purpose of this study was to discern revision quality, I selected the revision taxonomy developed by Faigley and Witte (1981), adding Bridwell's span categorization as they did (1980). This taxonomy makes a primary distinction critical to my study: revisions affecting the meaning of a text are separated from those which do not.

Methodology

To minimize the risk of focussing more intensively on certain writers in conference, I selected the four participants only after the end of the semester. I chose subjects who appeared to represent a range of the entire sample of writers. The four participants had the same primary motivation for enrolling in College Writing: all of them hoped to improve their writing. They varied in their writing apprehension and writing skill levels, and in college writing experience and computer experience. They also differed in the amount and kind of writing they expected of themselves or were expected to produce in school. Participants were not aware that their essays would be analyzed for revision changes and they received no

special instructions.

In sequencing assignments for the course, I drew upon the theoretical model constructed by Moffett (1968). Writers began by writing about issues and events close to their personal lives and gradually decentralized by moving into a more impersonal universe. Writers wrote five pieces during the course: an autobiographical essay, a biographical essay, a process paper, and two extended essays. Writers were responsible for selecting the content, the audience and the purpose for each essay they wrote.

Writers collected and numbered all drafts of their essays in their writing folders, logging the drafts as described above. For the revision analysis, I selected two pieces of writing from each of four case study participants, choosing a total of eight texts for analysis which seemed to represent a range of the texts written by writers in this study.

In Faigley and Witte's (1981) revision taxonomy, revision changes are first divided into two broad categories: surface changes and meaning changes. The researcher determines whether or not meaning is brought to or taken away from the text by a writer's revision. Punctuation and spelling changes, for example, seldom affect the meaning of a text, while information changes usually affect meaning. The distinction between surface and meaning changes is critical.

Once a revision is categorized as a surface change or a meaning change, four additional categorizations are made. Surface changes are subdivided into two categories: formal changes and meaning-preserving changes. Meaning changes are also subdivided into two categories: microstructure changes and macrostructure changes.

Neither type of surface changes ever affects the meaning of a text. Formal changes are largely editing changes such as spelling and punctuation. Meaning-preserving changes involve rearrangement of information without changes in the information base. In contrast, both sorts of meaning changes always involve changes in the information base of a text. Microstructure changes are the less radical; while these revisions affect discourse meaning, the overall textual summary is not affected. Faigley and Witte (1984) state that these changes are unimportant to the rest of the discourse. Macrostructure changes, on the other hand, involve major new information: a new character is added; the plot twists; ideas change directions.

Each revision made by a writer is given two numbers. The span length is the first number in the coding scheme. It is determined by the quantity of text involved: graphic (1); lexical (2); phrasal (3); clausal (4); sentence (5); multi-sentence (6) (Bridwell, 1980). Each revision operation also has its own number, and this is the second of the two code numbers. Meaning-preserving, microstructure and macrostructure changes involve additions; deletions; substitutions; permutations; distributions and consolidations of spans of text. Additions and deletions are exactly that: a span of text is added or deleted. A substitution is an exchange of a span of text which is synonymous with the original text. A permutation is a rearrangement of elements of a span of text, either internally (as movement within a sentence) or externally (as movement within the text). A distribution is movement of a span of text into multiple locations within the next draft. A consolidation condenses information in multiple locations

into a single span of text.

After mastering the taxonomy, I trained a colleague in its use in order to permit reliability checks. We analyzed revisions in three sets of the essays independently and then compared our analyses to reconcile differences, reaching 100% agreement in this way. Most differences were due to omissions of revisions. Some differences in categorization, however, were due to alternate interpretations of revisions, each equally valid. We selected the most consistent revision interpretation and added it to a list of rules. This method of achieving reliability was chosen over a quantitative reliability check because of the small number of texts, the complexity of the taxonomy and the need for extensive training. Consistent interpretation by two raters was judged to be more important than a quantitative inter-rater reliability score.

Using word count software, I calculated the frequency of changes per 1000 words in the final drafts, both for total changes and distinct categories. This conversion method, developed by Faigley and Witte (1981), had two distinct advantages: it allowed comparison with the data their own studies yielded, and it allowed comparison among the eight essays.

Examining revisions simply in terms of frequency, however, would be problematic for several reasons. First of all, when counting revisions, a punctuation change is counted once, just as is the addition of a sentence. But these changes are not really comparable, and frequency counts obscure this simple fact. Second, frequency counts seem to invite the assumption that copious revision of any kind is automatically good. This is not necessarily true. Expert writers have been found to revise less than

advanced student writers (Faigley & Witte, 1981).

Therefore, the frequency counts were used primarily as reference points, and the quality rather than the quantity of changes were of major concern. Interpretation involved a close examination of the quality of revision changes as measured by Faigley & Witte's revision taxonomy.

Results of the revision analysis showed that writers in this study made a mean of 164.56 revisions per 1000 words in final drafts (Table 1). All surface changes (both formal and meaning-preserving changes) accounted for 74.63 revisions. Of these, formal changes accounted for 31.61 revisions and meaning-preserving changes accounted for 43.02 revisions.

All meaning changes (both microstructure and macrostructure changes) accounted for 89.93 revisions per 1000 words. Of these, microstructure changes accounted for 44.41 changes while macrostructure changes accounted for 45.52 changes (if Susan's fourth cue is excluded from the calculations, however, mean macrostructure changes were 29.84).

Insert Table 1 about here

Participants varied widely both in the quantity and quality of revisions they produced, and writers tended to change their own revision emphases from one task to the next. But writers showed similarities as well. Notably, the writers in this study revised most frequently at the sentence level, with these revisions accounting for 44.3% of the mean revisions. Percentage categories for other categories break down as follows: lexical changes account for 21.3%; phrasal changes for 14%; graphic changes for 11.1%; and clausal changes for 9.4%. Multi-sentence changes accounted for a small percentage of the total revisions (4.7%). These long changes, however, tended to involve many sentences. Himada, for example, added 38 sentences in 4 long additions to his second task.

Any discussion of revision processes of writers working with word processing while receiving instruction must be preliminary and tentative due to the complexity of factors and the small number of participants and texts involved. Within these limitations, however, the results of this study support the following statements:

1. Idiosyncratic and fluctuating revision patterns indicate writers were influenced by more than word processing. Original composing processes, writing anxiety, instruction, computer experience and the demands of a given self-sponsored text were also important factors. Given the complexity of these interactive influences, isolation of any one influence of word processing proved infeasible.

2. All four writers in this study revised in ways which differed markedly from student writers in other research studies, making far more meaningful revisions of longer spans of text. Faigley and Witte (1981)

reported their student writers making the great majority of their revisions at the surface level, while writers studied here made less than half of their revisions at this level. Bridwell (1980) discovered that sentence level revisions accounted for only 8% of her high school writers' revisions, while over 44% of the revisions made by writers in this study were at the sentence level. Many researchers have discovered copious editing to be the primary revision activity of most student writers, while students in this study made only 11% of their changes at the editing level.

What accounts for these differences? Writing conferences were a critical part of this class. I taught students to revise for meaning, then organization, then sentence, word level and graphic concerns. In numerous writing conferences, both with peers and with me, writers learned to pay close attention to the content of their texts and to postpone editing while developing content and organization. The writing conferences took place in an ongoing writing workshop, and I tracked revision procesess in the context of real, ongoing and self-sponsored writing.

Word processing seems to have been an important secondary influence on writers, based upon student reports and my own teacher observations. Writers reported being much more willing to revise using microcomputers. They were able to act on reader responses without constant manual rewriting and retyping, a benefit most writers found highly advantageous.

These findings suggest that writing instruction which incorporated word processing was helpful to the students studied here. In addition, an important hypothesis emerges from these results. Using word processing while receiving process-oriented instruction, students can learn to make

meaningful changes in their writing in the course of a one semester writing workshop. They can move beyond the early obsession with surface mistakes, and they can learn to revise in far richer ways.

III. EXPERIMENTAL STUDY

Methodology

The purpose of the experimental portion of this study was to address the second of the two related research questions: what effect does the combination of writing instruction and word processing have on writing quality? In order to investigate this question, I conducted an experiment with 79 research subjects enrolled in our university's six sections of College Writing during the fall semester of 1984. Students did not know word processing was potentially a part of the classroom curriculum before enrolling. They self-selected into the six sections based upon various criteria, including time schedules, recommendations of academic advisors and peers, sections available at time of registration, and other unknown factors. The design was quasi-experimental because intact classes were used; classes were randomly assigned to experimental and control groups.

Research subjects formed a heterogeneous group, differing in admission status, ethnic background, writing experience and motivations for enrolling in College Writing. The mean year in college of research subjects was 1.8, with 63% of these students in their first year. Most subjects (70%) had not taken any college English/Writing courses. Regularly admitted students made up 44% of the population. Students admitted through the Educational Opportunity Program (EOP), a program for the economically and educationally disadvantaged, made up 34% of the population. The remaining 22% of the

participants were admitted through the university's evening division college. The primary reason students reported enrolling in College Writing was to improve their writing (52%). Most remaining students were advised by academic advisors to enroll in the course based on scores on the holistically scored university writing placement test given to incoming freshmen (41%).

Forty-four of the subjects were enrolled in four sections which did not incorporate word processing, and these four sections formed the control group for this study. Thirty-five of the students were enrolled in two sections which did integrate word processing, forming the experimental group for this study. These sections were taught by two volunteer teaching assistants, who, like the instructors for the control sections, were graduate teaching assistants enrolled in the university's English Education doctoral and master's programs.

Because of the statistical methodology used for this experimental study, instructional differences were recognized but not addressed. All classes received similar instruction with a similar theoretical basis. The individual student/teacher conference was the primary mode of instruction, and teachers helped writers to understand writing as a recursive, non-linear process by guiding them through processes of prewriting, drafting, revising and editing. Revision was stressed as the primary way writers make writing meaningful. Writing classrooms were decentralized, and teachers worked most often with individuals rather than groups, using the writer's own work as the major textbook.

All students enrolled in the six sections of College Writing wrote pre-

and post-test essays. The test, developed by the teaching staff, is an expository essay with a well-defined audience and purpose. Students received a broad range of content possibilities with the test to avoid penalizing them for insufficient prior knowledge on a given subject. Writers were required to select different topics for the pre- and post-test.

These 158 essays were evaluated by trained raters using holistic measurements (Cooper, 1977; Diederich, 1974; Myers, 1980). Raters did not know whether a given essay was a pre-test or a post-test or whether it was written by a student in a control or experimental section. Nor did raters know the identities of the student writers or their teachers.

The evaluators rated each essay on a scale from 1 to 6, with 1 the lowest possible score. Essay scores which fell within one score point were accepted. Essays which diverged more than one score point, however, were rated again. The sum of the two accepted ratings was the total score. Score point assignments were based upon an essay's relative success in fulfilling the positive characteristics established on a scoring rubric. These characteristics included a clear thesis; supporting detail; evidence of planning; engagement with the topic; a sense of audience; and mechanics. Raters trained extensively to establish point characteristics of essays from 1 through 6, and selected anchor essays to exemplify essays at each score point.

Since treatments were assigned to classes, not to individuals, a nested analysis of variance design (ANOVA) was selected. The nested ANOVA differentiated between the fixed treatment effects of word processing and writing instruction and the random effect of class differences.

After essays were rated holistically, inter-rater reliability was calculated using Pearson Product-Moment Correlation. Original score assignments were always used in calculations, even when scores differed more than one score point and raters reread and rescored the essays. Anchor essay scores were not included.

Results and Discussion

In all cases inter-rater reliability was greater than .80, ranging between .82 and .96. Using the Spearman-Brown prophecy formula, the reliability of total scores used in the analysis was estimated between .90 and .98.

The mean pre-test score for all students, including both control and experimental groups, was 5.56 (SD 2.30). The mean post-test score for all students was 6.41 (SD 2.28). The mean growth for all students, therefore, was .85 (SD 2.61).

Control group writers earned a mean pre-test score of 5.75 (SD 2.30) and a mean post-test score of 6.21 (SD 2.47). The mean pre-test score was 5.40 (SD 2.32) for experimental group writers while their mean post-test score was 6.66 (SD 2.01). Mean growth for control group writers, therefore, was .46 (SD 2.83) in contrast to 1.26 (SD 2.27) for experimental group writers.

The difference in gain scores reported above is statistically significant when analyzed using a nested analysis of variance design. Difference in teaching method is shown to be significant ($p = .03$). In other words, writers in the experimental group grew significantly more than writers in the control group, and this difference can be attributed to the effects of writing instruction and word processing. Class differences

within teaching methods, in contrast, are not significant ($p > .05$).

These results provide evidence that word processing is an assistive tool when used in the context of a process-oriented approach to composition instruction. Experimental sections of College Writing showed significantly more writing growth than control sections, despite the fact that the word processing sections contained the largest number of students. In contrast, writing development was consistently less pronounced in the smaller control sections.

What is the pragmatic meaning of these results? The difference between growth of .23 and .63 holistic score points on the original six point scale is statistically significant but practically moderate, and when this growth is viewed in absolute rather than comparative terms, neither group shows extraordinary improvement. The six point scale developed by holistic raters helps to put the issue of writers' growth into realistic perspective. Writers moving up in the point scale learned to state and elaborate a thesis in increasingly complex ways, and writers at the high end of the scale also tended to show greater audience awareness and engagement with the topic. Experimental group growth of .63 score points means, in terms of this scale, slightly improved ability to state and to elaborate a topic and may mean improved audience awareness and engagement. But the improvement is small and perhaps undistinguished in view of the instructional effort made. Experimental group gains may in fact be less noteworthy than the small progress of only .23 score points made by the control group.

Yet writers in the experimental sections did grow more rapidly, even though time spent learning word processing actually took time away from

writing instruction. What accounted for this difference in growth? Writers using word processing often reported devoting more time to writing, and time on task is a critical factor in writing development. Respondents using word processing reported being more willing to revise in particular, and revision skills are integral to mature composing styles. Motivation may have been a key factor as well: interest in new technology motivated some respondents, and ease of revising and editing processes motivated almost all of them. Respondents often reported more postive affective responses to writing as well.

In all likelihood, no one underlying cause exists for the greater writing development among experimental students. Rather, word processing is one of a complex interplay of factors affecting a writer's development, interacting with writing history, writing anxiety, type of instruction, learning style, time expenditure, motivation, attitudes and other unknown factors. The relative importance of any one of these factors was not measured in this study.

These experimental results require conservative generalization. First and most importantly, extreme caution is essential in making claims for word processing as a writing tool isolated from theoretically grounded writing instruction. This experiment took place within the context of a specific teaching model. Writing instruction and word processing were shown to help writers to develop, not word processing alone. The isolated use of word processing, in fact, has been shown to have little positive impact on revision processes (Collier, 1983). Second, a relatively small sample of six classes was studied. Third, writing growth was measured over the time

period of a single semester, a short time for writers to develop more viable writing processes.

Within these limitations, however, this experimental study yielded a promising finding: When a process-oriented teaching model was used, writers using word processing showed significantly more writing growth than similar writers not using word processing. This finding confirms observations made by many writers at varying levels of development as well as by many writing teachers: word processing can be a helpful tool enhancing writers' abilities to create discourse as well as providing incentive to do so. These promising findings merit additional investigation.

IV. CONCLUSIONS

Although definitive conclusions would be premature, this study yields preliminary conclusions which I present here as hypotheses to be tested in further studies.

Both student responses and experimental results indicated word processing in the writing classroom often positively influenced student writing processes and products. Use of word processing as a writing tool facilitated learning about writing, both motivating writers to revise and making revision mechanically easier. Writing conferences, however, appeared to be essential to writers revising in this study.

Student reports as well as revision analysis showed computer composing styles varied widely, making generalizations infeasible. Students used word processing in various ways and fluctuated widely in their revision choices and emphases, indicating each was influenced by a complex interplay of factors: original writing process, anxiety, instruction, computer

experience, word processing, and the demands of a given self-sponsored text.

Revision analysis indicated, however, that writers using word processing and receiving writing instruction revised differently from writers in other research studies, making far more meaningful changes and making many sentence level revisions. This phenomenon is attributed to the same complex interplay of factors, among them use of word processing as a writing tool. Because of the complexity of these interactive factors, a single influence of word processing did not emerge.

Experimental results showed writers using word processing improved significantly more than writers receiving similar instruction without word processing, providing evidence that word processing was a supportive writing tool helping writers to internalize successful writing processes. However, while the experimental sections developed more than the control sections, neither group demonstrated radical growth. Though shown to be a positive interacting factor in this experiment, word processing was clearly no panacea for writing difficulties.

V. IMPLICATIONS

Word processing is rapidly becoming a commonplace writing tool in schools and industry, and schools can help writers adjust to computer composing. Teaching implications can be drawn from this study to help integrate microcomputers into composition classrooms:

1. Microcomputers are valuable as writing tools enhancing writers' abilities to explore, to articulate and to reshape. Whatever the part of the writing process emphasized, teachers should be aware that writers learn to write holistically, and microcomputer uses should enhance this holistic

sense of discourse.

2. Microcomputers and word processing software in themselves will not help writers to learn how to write. Word processing can be a powerful tool, but the results of this study cannot be interpreted to mean word processing alone was helpful. Writing instruction is indispensable, and research shows writers learn best when writing is taught as a process in decentralized clasrooms. In doing so, the conference method of instruction is most valuable as a primary means of instruction. Computer-assisted instruction can help, but it cannot take over the central roles played by writers and respondents.

3. Microcomputers need to be used integratively, not in a theoretical vacuum. We need to employ great care when we integrate microcomputers into composition classrooms. This means avoiding software which concentrates exclusively upon subskills or isolates them prematurely. Software which neglects or fragments the holistic processes involved in writing is also unacceptable, and so is software which teaches grammar prescriptively while purporting to teach writing.

4. Teachers need to be trained in effective uses of microcomputers. This training should address selecting software and teaching students to use microcomputers. More importantly, teachers need to be aware of the theoretical bases of composition instruction, the available and appropriate teaching models, major pedagogical issues and controversies.

5. The choice of word processing programs is important and may shape writers' development. Especially when inexperienced writers and/or computer users are involved, the program should be user-friendly and easy to learn.

For novices, several components are key: simple commands, a readable manual, and straightforward movement among writing, editing and printing modes. No word processing program should be so complex that it distracts from thinking about writing.

6. Students need to be helped to find their own best uses of word processing. Writers who already have expert composing styles will have different needs and uses than basic writers without well-developed writing processes, especially revision processes. This need for individual intervention supports the use of word processing in one-on-one writing instruction.

7. Writers will always write in complex and idiosyncratic ways, and word processing programs do not yet and may never accommodate all writing styles. Writing teachers need to be aware of this and to give students alternatives to computer composing. On a practical level, this involves giving students separate, quiet writing space. On a pedagogical level, teachers need to give students the freedom to develop their own best composing styles, whether or not the microcomputer is intrinsic to them.

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Table 1

Total Measured Revision Changes per 1000 Words in Final Drafts for Eight Writing Cues

	Himada cue 1	Himada cue 2	Joan cue 1	Joan cue 2	Susan cue 1	Susan cue 4	William cue 3	William cue 4	Totals	$\bar{x}$
I. SURFACE CHANGES										
A. Formal changes (00)										
Spelling: 01	9.29	5.46	8.93	10.46	7.41	1.22	5.19	7.86	55.82	6.98
Tense, #, Modality: 02	0	10.93	0	2.09	1.06	0	7.78	2.31	24.17	3.02
Abbreviation: 03	0	0	0	9.41	1.06	1.22	0	.92	12.61	1.58
Punctuation: 04	5.58	9.11	60.27	21.97	3.70	1.22	21.40	7.86	131.11	16.39
Format a. paragraph: 05	0	6.38	11.16	2.09	1.06	1.22	0	.46	22.37	2.80
b. other: 06	0	0	2.23	3.14	0	0	0	1.39	6.76	.85
	14.87	31.88	82.59	49.16	14.29	4.88	34.37	20.80	252.84	31.61
B. Meaning-Preserving changes (10)										
Additions: 11	5.58	20.95	11.16	1.05	5.29	0	10.38	2.77	57.18	7.15
Deletions: 12	7.43	19.13	6.70	3.14	4.23	1.22	5.19	.93	47.97	6.00
Substitutions: 13	13.01	34.60	22.32	10.46	8.99	20.78	10.38	7.40	127.94	15.99
Permutations: 14	18.59	3.64	4.46	13.59	4.76	2.44	1.95	6.47	55.90	6.99
Distributions: 15	1.86	8.20	6.70	0	2.12	0	3.89	2.31	25.08	3.14
Consolidations: 16	0	6.38	17.86	1.05	.53	1.22	2.59	.46	30.09	3.76
	46.47	92.90	69.20	29.29	25.92	25.66	34.37	20.34	344.15	43.02
II. MEANING CHANGES										
A. Microstructure changes (20)										
Additions: 21	26.02	53.73	13.39	21.97	4.76	7.33	28.53	31.90	187.63	23.45
Deletions: 22	3.72	33.70	8.93	32.43	.53	6.11	3.24	5.09	93.75	11.72
Substitutions: 23	5.58	20.04	2.23	5.23	2.12	2.44	7.13	6.47	51.24	6.41
Permutations: 24	0	3.64	0	2.09	2.65	3.67	1.95	5.09	19.09	2.39
Distributions: 25	0	1.82	0	0	0	0	0	.46	2.28	.29
Consolidations: 26	0	0	0	0	0	0	1.30	0	1.30	.16
	35.32	112.93	24.55	61.72	10.06	19.55	42.15	49.01	355.29	44.41
B. Macrostructure changes (30)										
Additions: 31	13.01	14.57	24.55	30.33	26.98	85.58	29.83	26.81	251.66	31.46
Deletions: 32	0	6.38	17.86	7.32	3.70	64.79	0	1.39	101.44	12.68
Substitutions (33)	1.86	1.82	0	0	0	2.44	0	0	6.12	.77
Permutations (34)	0	0	0	1.05	.53	1.22	0	.93	3.72	.47
Distributions (35)	0	0	0	0	0	1.22	0	0	1.22	.15
Consolidations (36)	0	0	0	0	0	0	0	0	0	0
	14.87	22.77	42.41	38.70	31.21	155.25	29.83	29.13	364.17	45.52
TOTALS	111.53	260.48	218.75	178.87	81.48	205.34	140.72	119.28	1316.45	164.56

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